“Overview of existing chemical industry energy installations”

Bruce A. Hedman

Dr. Hedman is responsible for Onsite’s consulting services business and has over twenty years of experience in energy and environmental technology development, new product commercialization, and market research and development. Before joining Onsite, Dr. Hedman was Executive Director of the Industrial Center Inc. in Arlington, Virginia, a natural gas industry technology transfer and market development organization focused on supporting commercial introduction of new natural gas technologies for industrial users. Prior to this, he was Senior Program Manager at Battelle Pacific Northwest Laboratory’s Washington, DC offices, providing strategic planning and policy analysis support on natural gas issues and end-use R&D.   Dr. Hedman started his career at the Gas Research Institute in Chicago, holding a variety of research management positions in power generation, alternative fueled vehicles and industrial end-use. When he left GRI in 1994, he was Group Manager, Industrial and Power Generation Products and responsible for the development and commercialization of new natural gas technologies for these priority markets. Dr. Hedman has a Bachelor of Science and a Ph.D. in Mechanical Engineering from Drexel University in Philadelphia, Pennsylvania.

On-Site Power Generation in the Chemicals Industry

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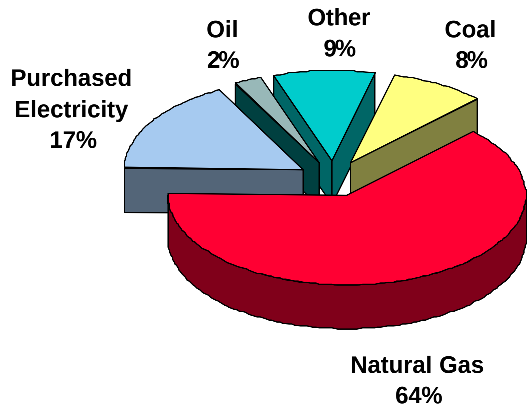
Chemicals Industry Overview

- $341 billion in shipments
- 70,000 different products
- Over $460 billion in assets
- 10.3% of manufacturing activity in the United States
- Energy consumption: 5.5 quads
  - 45% Feedstocks
  - 55% Heat and Power

The Chemicals Industry Uses almost 3 Quads of Energy for Heat & Power

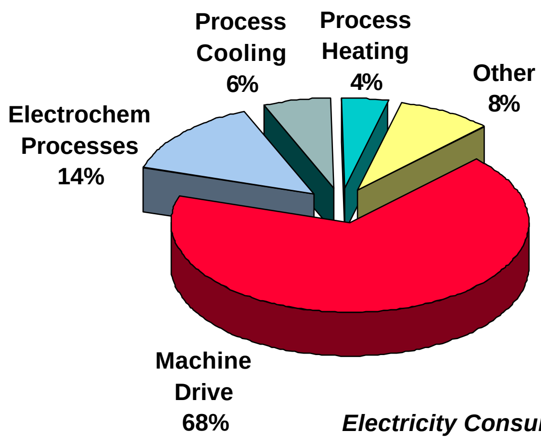


Source: 1994 MECS, DOE-EIA

Electricity and Steam Are Key Energy Elements

- Electricity consumption: 199.3 billion kWh
  - *Purchases: 156.3 billion kWh*
  - *Equivalent to 30 GW capacity*
  - *Cost of purchases: $5.3 billion*
- Steam Consumption: 123 million lbs/hour
  - *Cost of fuel = $3.6 billion*

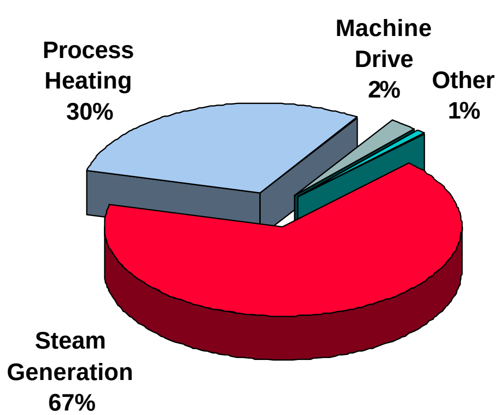
Machine Drive Is the Primary Use of Electricity in the Chemicals Industry



Electricity Consumption: 199.3 billion kWh

Source: 1994 MECS, DOE-EIA

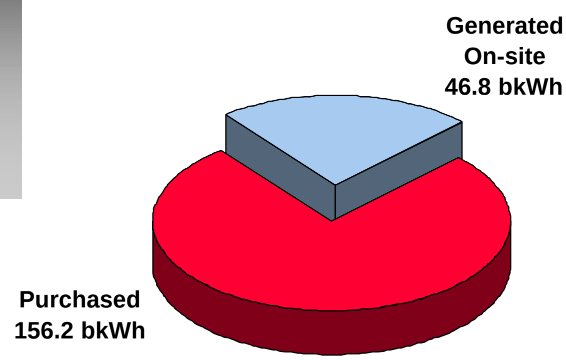
Steam Generation Is the Primary Use of Fuel in the Chemicals Industry



Fuel Consumption for Heat & Power: 2.53 Quads

Source: 1994 MECS, DOE-EIA

Self Generation Is an Important Source of Electricity for the Chemicals Industry

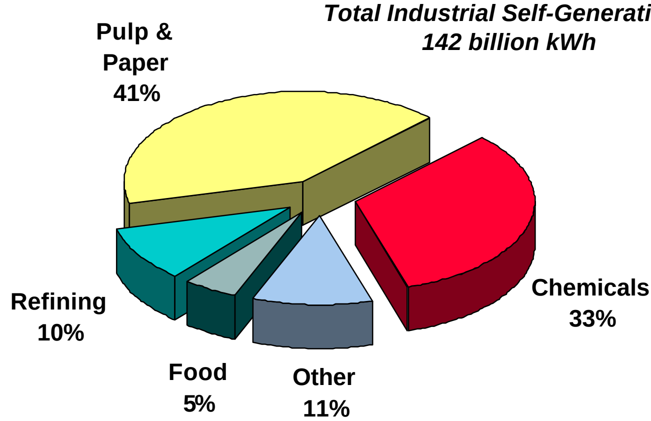


Internal Consumption: 199.3 billion kWh
Net Sale / Transfers: 3.7 billion kWh

Source: 1994 MECS, DOE-EIA

The Chemicals Industry Is a Leader in Self-Generation

Total Industrial Self-Generation:
142 billion kWh

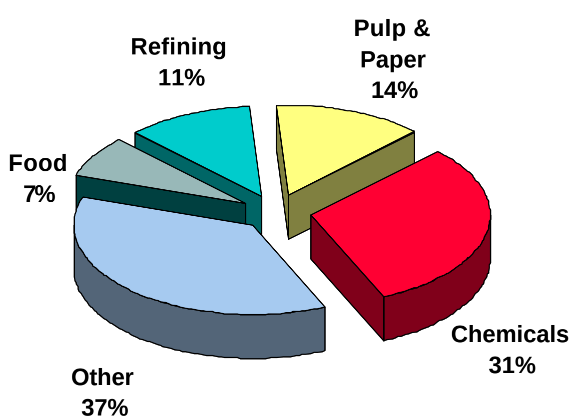


Source: 1994 MECS, DOE-EIA

Objectives of DOE/GRI Chemical Industry Assessment

- Characterize the current cogeneration market
- Quantify remaining on-site generation potential
- Analyze market drivers and barriers
- Recommend proactive strategies

The Chemicals Industry Has Led in the Post-PURPA Development of Cogeneration



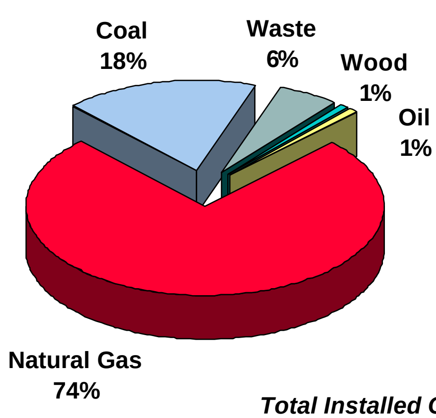
Post-PURPA Capacity Additions: 30 GW

Source: Haglar, Bailly

Profile of Post-PURPA Cogeneration in the Chemicals Industry

- 162 cogeneration facilities installed
- 12,500 MW of capacity
- 1/3 of the systems are larger than 40 MW
  - *89 % of capacity*
- 1/2 of the systems are smaller than 20 MW
  - *3 % of capacity*

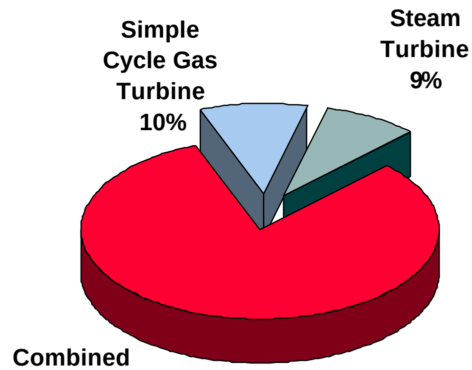
Natural Gas Is the Preferred Fuel



Total Installed Capacity: 12,500 MW

Source: Haglar, Bailly

Gas Turbines Are the Preferred Technology

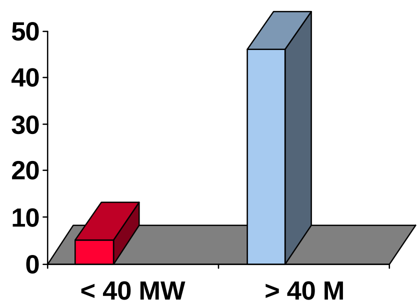


Total Installed Capacity: 12,500 MW

Source: Haglar, Bailly

Third Party Ownership of Cogeneration Facilities Is Not Uncommon

Percent of plants owned by 3rd Parties

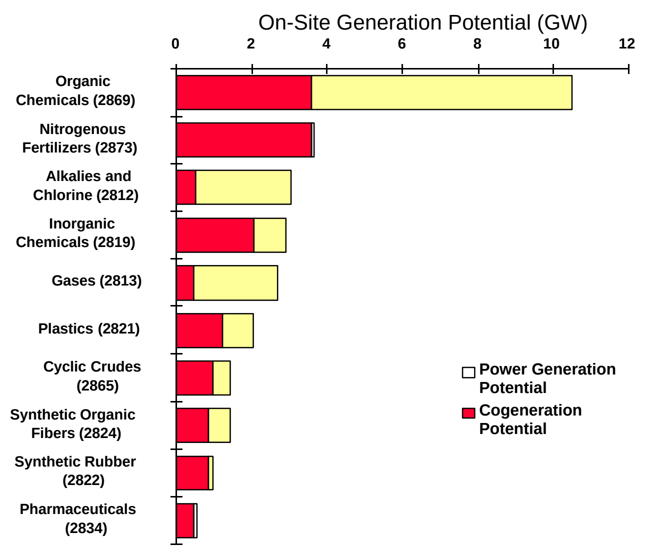


Source: Haglar, Bailly

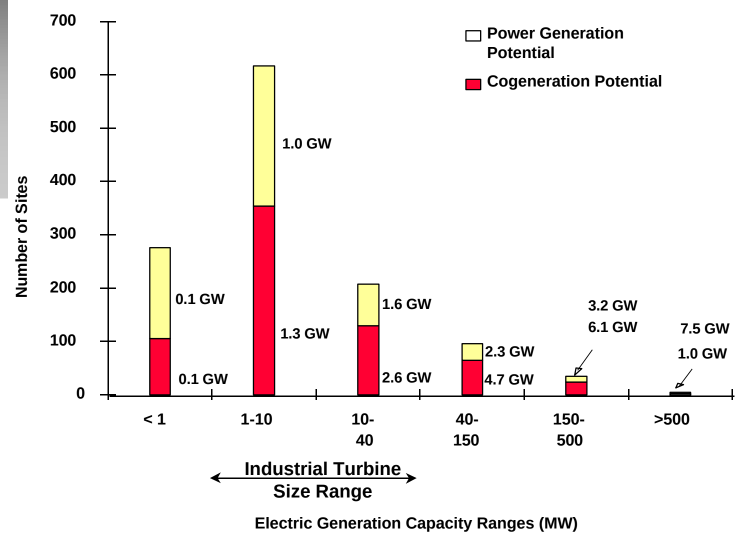
Market Outlook

- Significant potential remains for on-site generation in the chemicals industry
- Less than 10 percent of chemicals plants currently cogenerate
- Over half of the remaining plants have electric to steam ratios favorable for cogeneration.
- Technical potential for additional cogeneration is 15.8 GW
- Technical potential for systems in the 1-40 MW range is 3.9 GW

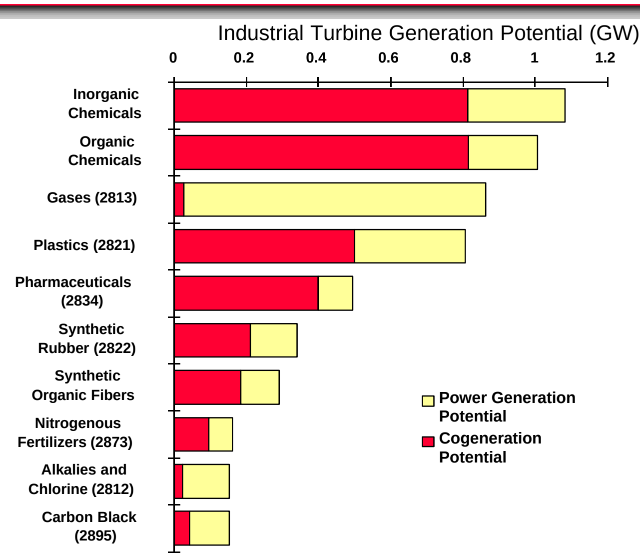
Total On-site Power Generation Potential by Subsector



On-Site Generation Potential by System Size



On-Site Generation Potential for Industrial Turbines



Subsector Rankings for Industrial Turbine Cogeneration Acceptance

TITLE	Total Energy Cost	Operating Cogen Plants	Energy Cost as % Shipment Rank	Market Saturation	Overall
ORGANIC CHEM	High	High	Medium	Low	**High**
INORGANIC CHEM	High	High	Medium	Low	**High**
INDUSTRIAL GASES	High	High	High	Low	**High**
ALKALIES/CHLORINE	High	High	High	Low	**High**
PHOSPHATIC FERT	High	High	Medium	Medium	**High**
PLASTIC	High	High	Low	Low	**Medium**
CYCLIC CRUDES	High	Medium	Medium	Low	**Medium**
PHARMACEUTICAL	High	Medium	Low	Low	**Medium**
ORGANIC FIBERS	High	High	Low	Low	**Medium**
NITROGENOUS FERT	Medium	High	Medium	Low	**Medium**
CHEMICAL PREP	Medium	Medium	Low	Low	**Medium**

Market Issues

- *Electric industry restructuring should enable on-site generation to compete*
- *Market will be driven by productivity and efficiency*
  - *Lower operating costs*
  - *Heat recovery*
  - *Power quality and reliability*
- *Environmental benefits need to be recognized*
  - *Climate change*
  - *Air pollutants*
- *Third party financing and partnerships can promote wider acceptance*